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The evolution of Baltic scientific journals

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Abstract
This study examines the evolution of scientific journals in the Baltic states, Estonia, Latvia, and Lithuania, through a scientometric lens, assessing their international integration, publication trends, and impact within the global research ecosystem. Using Scopus and SciVal databases, we analysed 49,695 articles from 122 Baltic journals indexed in Scopus, focusing on quartile rankings, subject area distributions, citation impact, and international collaborations. The findings reveal that while the number of Baltic journals has increased significantly since 1990, these journals remain largely positioned in the lower quartiles (Q3 and Q4), with few achieving Q1 status. Social sciences and humanities dominate the Baltic publishing landscape, yet these disciplines exhibit relatively low citation metrics compared to STEM fields. International collaboration remains limited, with single-country publications (SCPs) prevailing, though a notable rise in co-authorship with Chinese scholars in Lithuanian journals has emerged. Despite digitalization efforts, there are still systemic problems. Peer review challenges persist due to small academic communities and language barriers. Furthermore, Baltic journals are not visible internationally. Citation impact remains modest, with older articles experiencing diminishing citation rates over time. Our study highlights the need for enhanced journal management practices, greater international collaboration, and increased indexing efforts to improve the global visibility and prestige of Baltic journals.

Keywords Baltic journals · Scientometrics · International collaboration · Baltic states · Academic publishing

Introduction

A growing body of scientometric research has examined the position of local and national journals over the last two decades, especially within the global system of scholarly communication. Literature has consistently shown that journals originating or emerging from semi-peripheral and peripheral regions face structural challenges in

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achieving international visibility and reputation, citability, impact and prestige, or more technically, even sustained integration into global indexing systems, even when formally included in major databases such as Scopus or Web of Science (Demeter, 2018a, 2018b, 2020; Grančay et al., 2017; Lendvai, 2025b; Pajić, 2014; Sasvári & Lendvai, 2024). These challenges are particularly pronounced in the social sciences and humanities, where national languages (and thereby the well-documented linguistic barriers), locally oriented research agendas and subject topics, systemic academic barriers, often funding and financial constraints, as well as smaller academic communities continue to shape publication practices (Demeter, 2020). Research from Central, Eastern, and some countries in Southern Europe (for example the Balkan states or smaller Southern nations) serve illustrative examples of how locally embedded journals often exhibit what can be described as a "globally national" orientation where scholars strive for international recognition while remaining anchored in domestic scholarly ecosystems (see (Pajic & Jevremov, 2014; Grančay et al., 2017). Similar patterns have been documented for Croatian social sciences and humanities journals (Macan et al., 2016), Central European journals indexed in Web of Science (Bucher, 2018), and the broader publishing behaviours of Central and Eastern European scholars under increasing performance pressures (Demeter, 2020; Grančay et al., 2017).

Despite this expanding literature on the enlarging core and periphery in academic knowledge production (Demeter, 2018b, 2019, 2020), the Baltic states, namely, Estonia, Latvia, and Lithuania. remain comparatively underexplored as a collective case in large-scale scientometric analyses of local Scopus-indexed journals (cf. Zavadskas et al., 2011). Thus, the "Baltic case" offers a valuable opportunity to examine how local journals navigate international visibility under conditions that are largely unique as these countries are neither fully peripheral nor core in European research (cf. Sasvári and Lendvai (2024) who argued the same uniquely peripheral status of the Visegrad countries). The study at hand undertakes the investigation of the evolution of Scopus-indexed journals published in the Baltic states from a longitudinal scientometric perspective. We analyze journal-level prestige indicators, publication and citation trends, and patterns of international collaboration with the ultimate aim to situate Baltic journals within broader debates on the internationalization and stratification of scholarly communication.

The focus on exclusively Scopus-indexed journals is analytically motivated based on earlier pertaining literature. In many semi-peripheral research (and scholarly) systems, inclusion in major international indexing databases functions as a key institutional signal of legitimacy and quality, closely tied to national research evaluation frameworks, funding allocation mechanisms, and academic career advancement (Pajić, 2014; Sasvári et al., 2019; Sasvári & Fejes, 2023). As noted most notably in the case of Central and Eastern European countries, publication in Scopus-indexed journals has increasingly been incorporated into performance-based research assessment systems, creating strong incentives for both scholars and journal editors to pursue international indexation (see Hajdú & Sasvári, 2025; Sasvári & Fejes, 2023; Sasvári & Belényesi, 2024). The Baltic states, therefore, represent a particularly instructive case in this regard. As small research systems with limited domestic scholarly markets, the three Baltic countries have faced heightened pressure to internationalize their journals as part of European integration efforts (Kuznetsova & Gapanovich, 2012; Lovakov et al., 2022; Šuminas et al., 2025) and Scopus, being one of the largest and most renowned international repository (Baas et al., 2020) serves as a critical subject to examine how local academic constraints interact to shape journal trajectories in semi-peripheral contexts.

A brief history of baltic research

The Baltic States are a European region on the eastern shore of the Baltic Sea, covering the territories of Estonia, Latvia, and Lithuania with a population of approximately 6.1 million. The first individual scientific journals appeared in Lithuania at the beginning of the twentieth century, along with the birth of the ideas of statehood in the Baltic states (Krutulys, 2021). During this period, the initiative to publish scientific journals was taken by higher education and scientific institutes, also by individuals, various scientific societies, state ministries and by the time of the Second World War, the number of scientific journals and their publishers had grown quite rapidly in all three Baltic States.

After World War II, the statehood situation of the Baltic States changed (they were occupied by the Soviet Union), the political system, and with it the scientific policy and general conditions of publishing activities. The right to scientific publishing was taken away from universities, associations, societies and, of course, individuals (see Ilmjärv, 2008). The largest scientific publishers of the Soviet era were the academies of sciences and other government institutions: committees, ministries, while publishing in universities shrank to a minimum. Although scientific journals in the Soviet Union (including the occupied Baltic states) were relatively less ideologically constrained than regular periodicals or books, during the Soviet period (1945–1989) the number of scientific journals grew slowly, it was very difficult to establish them, for which permission had to be obtained from the Central Committee of the Communist Party of the Soviet Union in Moscow (Stepanov, 2014). The Soviet Union, trying to satisfy its economic needs, focused mainly on natural and technological sciences, while less attention was paid to medical and social sciences, for example, in Lithuania social science journals accounted for about 12 percent of all Soviet-era journals (Petreikis et al., 2024a, 2024b).

At the end of the Cold War era, some outstanding research institutes in the disciplines of life and material sciences were developed in the Baltic countries, primarily to serve the needs of the Soviet Union's military industry. In contrast, the social sciences were largely underdeveloped, as they were required to align with the ideology of the existing regime. The Association for the Advancement of Baltic Studies (AABS), an international educational and scholarly non-profit organization, was founded in 1968 at the University of Maryland (USA) to provide a platform for scholars to present research related to Baltic studies. To this day, AABS publishes a multidisciplinary scholarly journal that primarily focuses on the social sciences and humanities of the Baltics.

Following the restoration of independence in 1990, the Baltic states inherited a fragmented and outdated Soviet era science dissemination system, leaving them significantly behind Western Europe in research infrastructure and publication practices (West & Lowe, 1998). In response, each country adopted distinct research funding models: Latvia implemented a grant-only system, Estonia introduced competitive grants gradually, and Lithuania maintained institutional funding with limited project-based support (Kristapsons et al., 2003). Despite joining the European Union in 2004 and integrating into the European Research Area, Baltic countries continued to lag in research investment, with R&D expenditures in 2023 remaining below the EU average (Bukovskis & Kasekamp, 2022; Eurostat, 2023; Puntikov & Tkachenko, 2013). Efforts to align with EU standards led to increased funding for innovation and education (Kunicina et al., 2023).

In terms of research collaboration, the region remained relatively isolated for years. Structured international cooperation only began to take shape after EU accession, notably through the Baltic Research Programme (2014–2021), funded by EEA and Norway

Grants (EEA Grants, 2025), and later through trilateral initiatives with partners like China and Taiwan. These developments marked a shift toward aligning national research agendas with broader EU priorities, such as Horizon Europe (Bukovskis & Kasekamp, 2022), setting the stage for examining the evolution and internationalization of Baltic Scopus indexed journals.

In the present research we aim at outlining the development of Baltic journals with a particular focus internationally indexed journals following similar scientometric investigations that concerned more peripheral or developing regions (Alperin & Rozemblum, 2017; Demeter, 2017, 2020; Lendvai, 2025a, 2025b; Sasvári & Lendvai, 2024; Wang et al., 2017) to understand how Baltic knowledge dissemination occurred and evolved in local journals.

To investigate Baltic journals, we propose the following research questions (RQ):

- RQ1: What longitudinal trends can be identified in the indexing, publication output, and prestige of Baltic journals indexed in Scopus?
- RQ2: How international are Baltic journals and what are the collaboration trends?

Examining these two questions will allow us to provide a descriptive understanding of how Baltic journals have emerged and how visible they are. We are hopeful that the present research will be an important addition to the discourse on journal and publication trends in more marginalized and peripheral regions (Demeter, 2020). Our paper also aims at updating Zavadskas et al.'s (2011) research on Baltic publication patterns published almost 15 years ago with more data and insights.

Materials and methods

For the present research we used Elsevier's Scopus and SciVal, two databases related to each other and widely considered as one of the most comprehensive scientific repositories with the most reliable metadata (Baas et al., 2020). Scopus was preferred to other repositories also due to the fact that it has the widest coverage of journals especially in regard to regional journals from different disciplines (e.g. social sciences) (De Moya-Anegón et al., 2007). We collected data of journals using the Scimago Journal Rank (ScimagoJR) database as it stores all journals from Scopus with a quartile assigned (González-Pereira et al., 2010). The data collection occurred on 1 February 2025.

The procedure of the data collection from ScimagoJR was done via filtering journals based on their regional affiliation. We selected the three Baltic states, Estonia, Lithuania, and Latvia, and collected every journal from the database that has ever been indexed in Scopus. We found, in total, 34 journals from Estonia, 73 journals from Lithuania, and 15 journals from Latvia. As our investigation specifically concerns journals and document types represented in them based on a well-established methodological consideration concerning journal evaluation (Pouris, 2005; Sasvári & Lendvai, 2024; Teodorescu & Andrei, 2011), we excluded conference proceedings, books, and book chapters.

Based on the journals' data extracted from Scopus via ScimagoJR, we collected all documents in Scopus including all their available metadata. We have created a dataset of a total of 49,695 documents which included all entries published in Baltic journals before 2023. The first published work was indexed in Scopus in 1975. 2023 as the end year was chosen as at the time of the writing this was last available time criteria in ScimagoJR. For the bibliometric data analysis (RQ1) we employed bibliometrix, a renowned an R package

that provides comprehensive tools for quantitative research performance analysis, including citation analysis, co-authorship networks, and thematic mapping (Aria & Cuccurullo, 2017).

For our analysis we used indicators such as the SJR score as well as the Q quartile. The SJR score is a prestige metric that measures the scientific influence of journals by accounting for both the number of citations received and the prestige of the citing sources, using a weighted network-based approach (Falagas et al., 2008) while the Q quartile assignment is related to the categorization of scientific journals into four groups (Q1 to Q4) based on their impact within their subject category, with Q1 representing the top 25% of journals (highest impact) and Q4 representing the bottom 25% (lowest impact) (Vîiu & Păunescu, 2021) (Table 1).

We have also used Gephi, a network-visualization software tool for constructing and visualizing bibliometric networks, including co-authorship, citation, and keyword co-occurrence maps, using a distance-based clustering approach to examine RQ2 on collaborations. As we are mainly interested in collaborations, we conducted a co-authorship analysis by country (see Isfandyari-Moghaddam et al., 2021). We used Gephi's Fruchterman Reingold layout for visualization, networks were partitioned by modularity class, furthermore, we only display the largest connected set of items to declutter the density of the figures. The exact network data are detailed for each country-analysis under "Collaboration network (RQ2)" section. All network statistics can be found under Appendix 1.

In certain cases, where otherwise not indicated, we generated visualizations via Python's matplotlib (Hunter, 2007).

Results

Journal and publication trends in the Baltics (RQ1)

As we inspected all journals in the Baltics, we specifically examined the subject categories assigned to each journal in Scopus in the three nations. To filter out the most occurring categories, we specifically focused on the top 3 most represented categories. It is to be underlined that certain journals have more than subject categories assigned; we included every subject category separately. In general, social sciences and humanities dominate the

Table 1 Main information data of the publications analysed

Timespan	1975:2023
Documents	49,695
Annual growth rate %	18.55
Document average age	10
Average citations per doc	6.227
Keywords plus (ID)	64,927
Author's keywords (DE)	114,065
Authors	68,526
Authors of single-authored docs	8972
Single-authored docs	14,696
Co-authors per doc	2.76
International co-authorships %	13.3

top subject categories with linguistics and language and history being among the most prominent areas in each country. As for Lithuania, sociology and political science, as well as education have also been included in the top 3. However, it is to be highlighted that in view of the percentage rates of representation, there is no particular subject category that overwhelmingly dominate the knowledge production in either country's journals (Table 2).

As the prestige and visibility of journals is generally aligned with their respective quartile ranking (García et al., 2011a, 2011b), we have also examined the "Best SJR Quartile" (Best Q) for each journal which represents the highest quartile a journal has achieved within the examined period, with Q1 being the most prestigious and Q4 the lowest (García et al., 2011a, 2011b). In general, there is a lack of "elite" journals in the Baltics as only a small minority of journals achieved a Q1 ranking in the period of their indexing Scopus. This result is more accentuated regarding Lithuania, as only 4 journals out of 73 to ever achieve a Q1ranking. On the other hand, there is a high number of journals (80) to be positioned in the Q3–Q4 quartiles. In view of the top subject categories, it is also to be mentioned that the most frequent category to be presented in terms of top Q (Q1), journals in linguistics and language are the most successful (5 occurrences, 15.62% of all Q1) and cultural studies (4 occurrences, 12.5% of all Q1) (Fig. 1).

Lastly, we investigated prestige in view of the more nuanced SJR score, too. We rounded up SJRs to two decimals and found extremely low scores among the 111 journals examined. In general, journals with a lower SJR score than 1.00 are considered to have less scientific visibility and influence (Falagas et al., 2008; Sasvári & Lendvai, 2024) (Table 3).

Following our earlier investigation regarding SJRs, we were also interested in top journals in the Baltic states in terms of publication count and prodcutivity. The Lithuanian *Journal of Vibroengineering* leads in article output in the examined period with 3166 publications, significantly ahead of the second-ranked *Elektronika ir Elektrotechnika* (Lithuania), which has 2185 articles. *Agronomy Research* (Estonia) follows in third place with 1795 publications, followed by *Mechanika* (Lithuania, 1477 articles) and *Magnetohydrodynamics* (Latvia, 1414 articles). What is particularly interesting, especially with regard to our SJR analysis, is that despite the prestige of social sciences, there is no journal in either therein or in humanities in the top 10 most productive sources. Though there is strong representation of engineering, physics, and applied sciences suggests a dominant focus on

Table 2 Distribution of top subject categories in Scopus by countries

Country	Rank	Categories	Count	%
Estonia	1	Linguistics and Language	8	3.03
	2	Cultural Studies	7	2.65
	3	History	5	1.89
Latvia	1	History	5	1.89
	2	Visual Arts and Performing Arts	3	1.14
	3	Arts and Humanities (miscellaneous) Cultural Studies Engineering (miscellaneous) Linguistics and Language Literature and Literary Theory	2	0.76
Lithuania	1	Linguistics and Language	10	3.79
	2	Sociology and Political Science	8	3.03
	3	Education	7	2.65

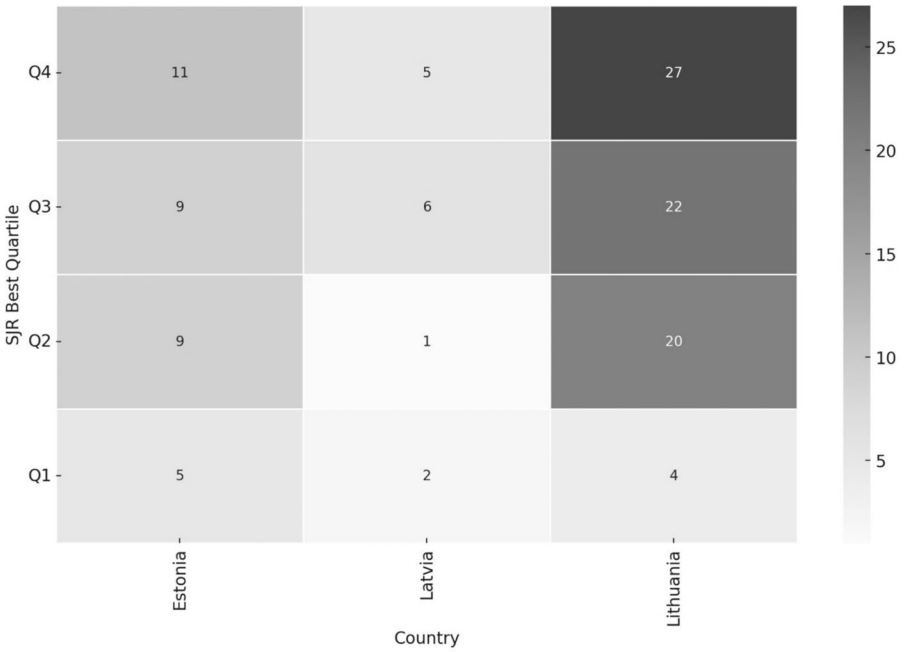

Fig. 1 Distribution best Q rankings by country

Table 3 SJR analysis of Baltic journals (rounded up to two decimals)

Country	Jornal count	Mean	Std	Min	25%	50%	75%	Max	Highest SJR Journal
Estonia	34	0.2	0.14	0.1	0.12	0.17	0.24	0.83	Estonian Journal of Archaeology
Latvia	14[a]	0.18	0.07	0.1	0.1	0.18	0.24	0.29	Transport and Telecommunication
Lithuania	73	0.24	0.16	0.1	0.14	0.19	0.27	0.86	Technological and Economic Development of Economy

[a]As for Latvia, there is one journal which is indexed in Scopus but has never been ranked in any quartile (*Baltic Journal of English Language, Literature and Culture*, ISSN: 16919971, 25010395)

technical and industrial research areas which may indicate a mix of interdisciplinary fields, the lack of non-material or natural sciences showed a surprising result (Fig. 2).

Having analysed the journals, we aimed to outline a more detailed trend overview based on a microanalysis, publication examination. In the late 1970 s and 1980 s, publication numbers and indexation in Scopus were relatively low, with fluctuations such as 86 publications in 1978, 55 in 1979, and a peak of 101 in 1990—mainly due to the newly-gained independence of the Baltic countries—before dropping to zero in 1992 to 1994. The late 1990 s saw moderate growth, with 101 publications in 1996, 98 in 1997, and 117 in 1999. However, a sharp increase began in the early 2000 s, with 317 publications in 2003, jumping to 761 in 2006 and nearly doubling by 2008 to 1705 publications. This rapid acceleration continued through the 2010 s, reaching 2580 in 2013 and 3155 in 2017, peaking at 3594 in 2021. While the general trend remains upward, there are slight fluctuations in recent years, such as a dip to 3429 in 2022 before recovering

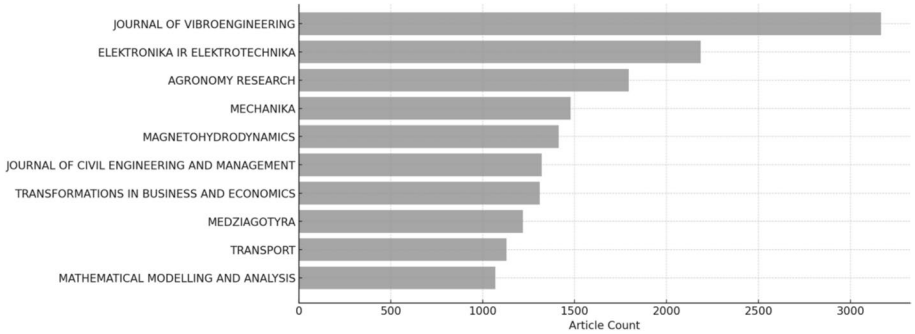

Fig. 2 Most productive journals in the Baltics

to 3533 in 2023. A polynomial trendline was fitted to the data, yielding an R^2 value of approximately 0.95, indicating a strong correlation between time and publication count growth which also suggests that publication output has not only increased but has done so at an accelerating rate, particularly since the twenty-first century (Fig. 3).

As citations are one of the primary factors in evaluating the impact of an article, we analysed the citation metadata of all publications (Gupta et al., 2023). The mean total citations per year ("Mean TC per Year") are low and the rate varies significantly, ranging from 0.00 to 0.85, with an average value of 0.32. The mean total citations per article (Mean TC per Article) shows even greater dispersion, fluctuating between 0.00 and 10.43, with an average of 4.57 citations per article. We have also used another metric, Citable Years. By Citable Years we mean the number of years that is available for citations. For instance, if an article was published in 2022, its Citable Years will be 4, as it has been available for citing from 2022 to 2025 (4 years in total). In our dataset of publications, Citable Years range from 3 to 51 years. To better understand the relationship between citation accumulation and time, a quantile regression analysis was performed

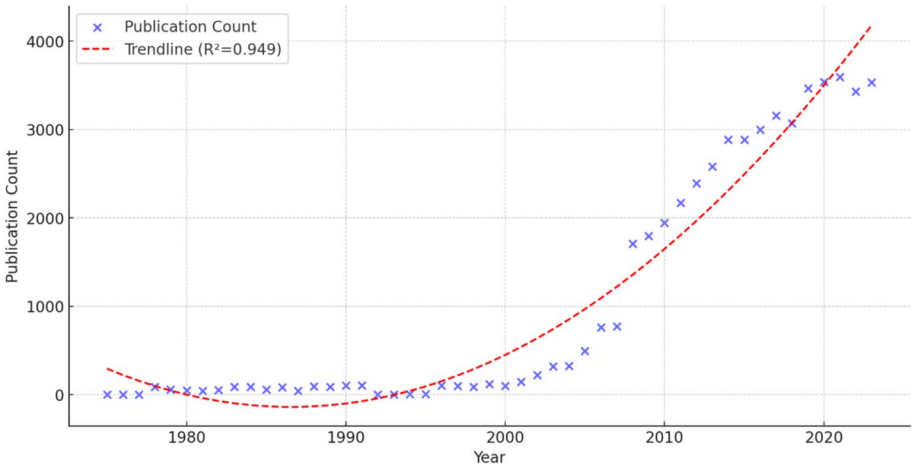

Fig. 3 Publication numbers and trends of Baltic journals

using Mean TC per Year as the dependent variable and Citable Years and Mean TC per Article as independent variables. The estimated model is represented as:

$$Q_\tau(MeanTCperYear) = \beta_0^{(\tau)} + \beta_1^{(\tau)} * CitableYears + \beta_2^{(\tau)} * MeanTCperArticle$$

The results reveal that Citable Years have a consistently negative impact on Mean TC per Year across all quantiles. At the 25th percentile, an additional citable year decreases annual citation accumulation by -0.0082 ($p < 0.001$***), while at the 90th percentile, the reduction is even stronger at -0.0186 ($p < 0.001$***). This suggests that older articles see a steady decline in their annual citation rate over time. On the other hand, Mean TC per Article exhibits a weak but positive effect on Mean TC per Year, particularly at lower citation levels. For articles in the 25th percentile, an increase in Mean TC per Article leads to a $+0.0282$ ($p = 0.01$ **) increase in annual citation rate. However, this effect diminishes at higher citation levels and is statistically insignificant for the 75th and 90th percentiles (Fig. 4).

Internationalization and collaboration trends of Baltic journals (RQ2)

To commence our analysis on internationalization we first created a dataset of all the metadata related to collaborations, including the authors' affiliation and the affiliation's country. As we included all disciplines, which often have differing standards and practices with regard to who happens to be the "lead" author of a journal (Smith, 2017), we also took into account the corresponding author's affiliation and country. We also used two indicators set forth in bibliometrix, the Single Country Publications (SCP) and Multi Country Publications (MCP) metrics, the former meaning that a collaborative work has been authored by scholars from one nation, the latter meaning that a collaborative paper has been authored by scholars of at least two differing nations. Our dataset highlighted Lithuania as the most prolific country in terms of corresponding author contributions, accounting for 8679 articles (17.5%), with a high proportion of SCP at 7949 and a relatively low MCP share of 8.4%. This suggests that Lithuanian research is predominantly domestically driven, with fewer international collaborations. However,

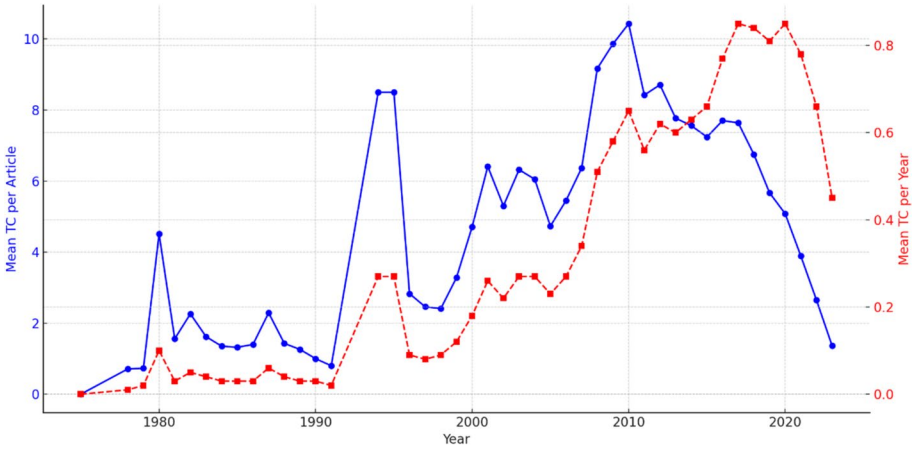

Fig. 4 Citation analysis of publications in Baltic journals

an exceedingly intriguing result emerged as China has become one of the most significant contributors in Lithuania, ranking second with 4665 articles (9.4%), demonstrating a strong research presence. Unlike Lithuania, China has a higher MCP share of 14.9%, indicating stronger international collaboration compared to other top-ranking countries, however, it is also to be underlined that when Chinese scholars publish collaborative articles in Lithuanian journals they mostly do so with other Chinese colleagues. Estonia follows with 3306 articles (6.7%), maintaining a balance between SCP and MCP at 13.1%, reflecting moderate international engagement. Latvia contributes 1638 articles (3.3%), with a lower international collaboration rate (11.1% MCP share) than Estonia. Poland, while slightly lower in total output (1496 articles, 3.0%), has a higher MCP share of 13.0%, suggesting a greater tendency toward cross-border cooperation. Other countries in terms of representation include Turkey, Russia, the Czech Republic, Ukraine, and India. There is also a notably hiatus in terms of Global North countries with the few of them ranking incredibly low in corresponding authorship count (Fig. 5).

The dataset reveals that Lithuania leads in research production, contributing 8679 articles (17.5%), followed by China with 4665 articles (9.4%). Estonia, Latvia, and Poland follow with 3306 (6.7%), 1638 (3.3%), and 1496 (3.0%) articles, respectively. A trend analysis of annual publication growth shows that Lithuania has the steepest increase in Scopus-indexed journals, with a growth rate of approximately 699.3 articles per year ($R^2 = 0.887$, $p < 0.001$***), indicating a highly predictable upward trajectory. China follows with an annual increase of 289 articles ($R^2 = 0.669$, $p < 0.001$***), suggesting steady growth but with more fluctuations compared to Lithuania. Estonia exhibits a growth rate of 204.7 articles per year ($R^2 = 0.831$, $p < 0.001$***), while Latvia and Poland show nearly identical growth trends, with 107.95 and 107.12 articles per year, respectively (both $R^2 > 0.82$, $p < 0.001$***). The high R^2 values across all five countries indicate that time is a strong predictor of research output, meaning these publication trends are expected to continue. Lithuania's dominance is largely driven by domestic research, as indicated by its low Multi-Country Publications (MCP) share of 8.4%, while China's rise is accompanied by a significantly higher MCP share of 14.9%, reflecting stronger international collaborations. Estonia and Poland also show higher

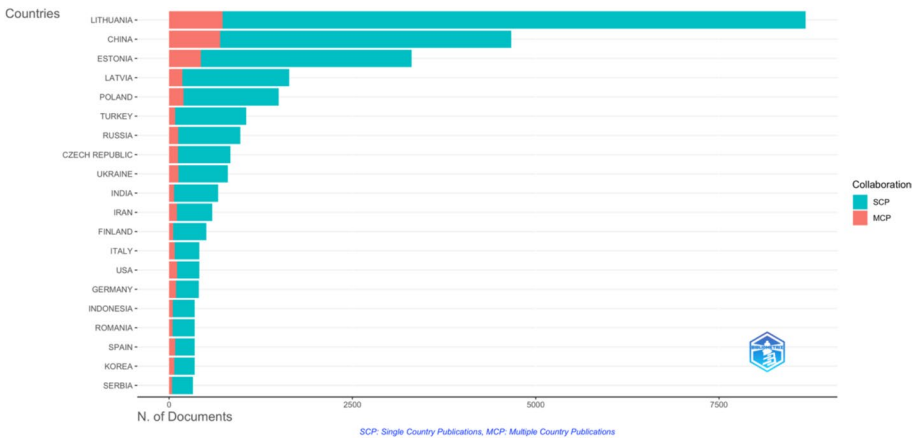

Fig. 5 Analysis of co-authored publications by the corresponding author's country, SCP, and MCP

MCP shares (13.1% and 13.0%, respectively), suggesting more integration into global research networks compared to Lithuania and Latvia (Table 4).

We were particularly intrigued by China's presence, especially in Lithuania. To better understand how China emerged we specifically investigated the countries' growth in representation in Baltic journals. We used the following regression model to do so:

$$ln(Y_t) = ln(Y_0) + r * t,$$

where Y_t represents the total number of articles in year t, Y_0 is the initial research output, and r is the estimated growth rate. The analysis found that $r = 0.341$, meaning China's publication output is growing at an annual rate of approximately 34.1%**.** This exponential trend is statistically highly significant ($p < 0.001$***), and the model's R^2 value of 0.967 indicates that 96.7% of the variation in research output is explained by time, demonstrating

Table 4 Contribution by country in publications published in Baltic journals

Country name	Top contributing countries	Articles	Articles %	SCP	MCP	MCP %
Estonia	ESTONIA	2970	27.7	2656	314	10.6
	LATVIA	555	5.2	490	65	11.7
	CZECH REPUBLIC	358	3.3	326	32	8.9
	FINLAND	294	2.7	264	30	10.2
	CHINA	243	2.3	209	34	14
	UKRAINE	212	2	192	20	9.4
	LITHUANIA	139	1.3	115	24	17.3
	TURKEY	135	1.3	120	15	11.1
	INDONESIA	116	1.1	98	18	15.5
	POLAND	105	1	83	22	21
Latvia	LATVIA	438	8.9	407	31	7.1
	RUSSIA	141	2.9	129	12	8.5
	POLAND	107	2.2	97	10	9.3
	GERMANY	74	1.5	48	26	35.1
	LITHUANIA	66	1.3	65	1	1.5
	UKRAINE	40	0.8	29	11	27.5
	CHINA	29	0.6	25	4	13.8
	CZECH REPUBLIC	29	0.6	23	6	20.7
	INDIA	27	0.5	25	2	7.4
	FRANCE	26	0.5	18	8	30.8
Lithuania	LITHUANIA	8488	24.3	7777	711	8.4
	CHINA	4421	12.6	3756	665	15
	POLAND	1293	3.7	1125	168	13
	TURKEY	925	2.6	855	70	7.6
	LATVIA	711	2	624	87	12.2
	INDIA	588	1.7	532	56	9.5
	UKRAINE	587	1.7	489	98	16.7
	IRAN	553	1.6	451	102	18.4
	CZECH REPUBLIC	453	1.3	370	83	18.3
	ESTONIA	448	1.3	365	83	18.5

the strength of this trend. Unlike a linear model where research output would increase by a fixed amount each year, we used an exponential model which resulted in the finding that China's publication growth compounds over time which means that past increases in research output contribute to even greater future increases, leading to an upward acceleration. The exponential fit line closely matches the actual data, reinforcing that China's rise in research production is not just rapid but self-reinforcing. If this trend continues, China is likely to surpass many other countries in research output within a short time frame, even Lithuania in their own domestic academic environment (Fig. 6).

Collaboration network (RQ2)

Lastly we examined collaboration networks by country. The co-authorship network in the case of Estonian journals shows a medium-sized but relatively cohesive structure, with 109 nodes and 729 edges. Both the average degree of 13.376 and high average weighted degree suggest that authors not only collaborate widely but also do so repeatedly with the same partners. A graph density of 0.124 confirms that a substantial share of all possible ties is realized, pointing to a tightly knit scholarly community. However, the moderate modularity score ($Q = 0.202$) reflects that there is only moderate community differentiation, thus, collaboration clusters are present but not strongly segregated. Latvia shows the smallest and sparsest network, consisting of 79 nodes and 344 edges. The average degree is also the lowest (8.709) and Latvian journals' co-authorship patterns also show markedly lower average weighted degree. Although the graph density of 0.112 is not dramatically lower than Estonia's, it emerges from a more fragmented collaboration landscape. Similarly to Estonia, Latvia's modularity of 0.189 also presents a relatively loose community structuring, however with even more of a dispersed co-authorship pattern. Lithuania stands out as it is by far largest and most intensive network in comparison to the other two countries. The network consists of 134 nodes and 1319 edges. The average degree is the highest also in the case of Lithuania (19.687) paried with an exceptionally high weighted degree. The graph density of 0.148, the highest among the three which also points to a strongly interconnected research community.

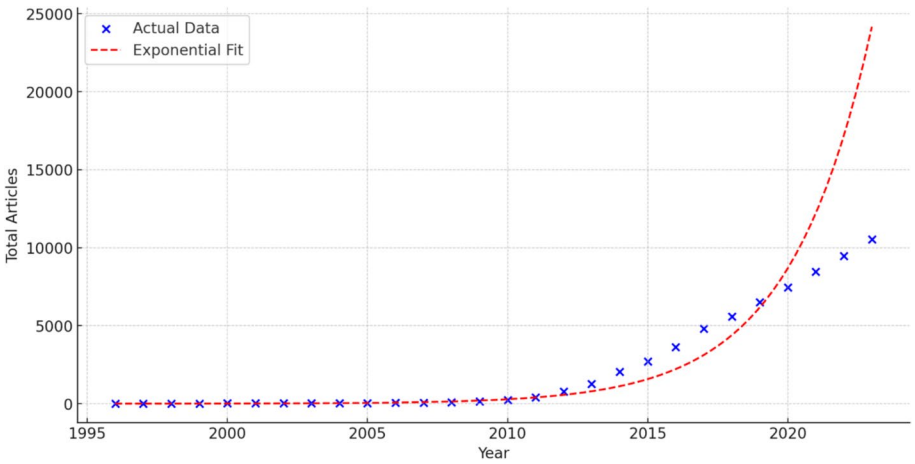

Fig. 6 Exponential analysis of China's growth in research outputs in Baltic journals

The modularity value though still relatively small (Q = 0.216) compared to the Estonia and Lithuania, it still suggests a relatively clearer sub-community formation (Table 5).

Focusing on the country-level co-authorship network of authors publishing in Estonian journals a strongly hierarchical and internationally oriented collaboration structure is revealed, dominated by a small number of highly central countries.

Estonia clearly occupies the core of the network, with the highest number of links (62) and an exceptionally high total link strength (942), reflecting both extensive and intensive collaborative engagement. This central structural position is mirrored in output and impact indicators, as well as a very high closeness value (0.70) and betweenness centrality values. Beyond Estonia, several large research systems play an important secondary role. The United States and the United Kingdom exhibit high degrees (54 and 40, respectively) and substantial weighted degrees (228 and 135), indicating strong and recurrent co-authorship ties with Estonian journals. Similarly, Germany, Finland, Sweden, and China combine relatively high connectivity with large publication and citation volumes, situating them firmly within the network's inner core. These countries also display elevated closeness centrality scores, suggesting efficient access to other collaborators through short path lengths. A long tail of countries with low degree values and minimal link strength occupies peripheral positions (Fig. 7, full node results are in Appendix 1, sheet 1).

The country-level co-authorship network of authors publishing in Latvian journals exhibits a strongly internationalized yet hierarchically structured collaboration pattern, with Latvia clearly occupying the central position. Latvia records the highest degree (40) and a very large total link strength (330). This structural prominence is reinforced by high closeness (0.645) and harmonic closeness centrality values. Latvia's substantial betweenness centrality (473.7) further highlights its role as a key intermediary connecting otherwise weakly linked national clusters. Several major European research systems form a dense secondary core, most notably Germany, United States, Russian Federation, and France, all of which display high degrees (ranging from 30 to 38) and strong weighted degrees. Nordic and other European partners such as Finland, Sweden, Poland, and Italy also occupy relatively central positions (Fig. 8, full node results are in Appendix 1, sheet 2).

Lastly, we examined Lithuanian journals. Lithuania records the highest degree in the network (77 links) and the highest total link strength (1053). Lithuania's network position is also exceptionally efficient, reflected in high closeness centrality (0.689) and harmonic closeness centrality (0.784), meaning it is only a short distance away from most

Table 5 Network metrics of co-authorship networks by country in the case of the three Baltic countries' journals

	Estonia	Latvia	Lithuania
Nodes	109	79	134
Edges	729	344	1319
Average degree	13.376	8.709	19.687
Avg. weighted degree	46.275	25.316	77.284
Network diameter	4	5	5
Graph density	0.124	0.112	0.148
Modularity	0.202	0.189	0.216
Statistical interference	2091.595	908.2	3286.212
Avg. path length	2.272	2.351	2.167

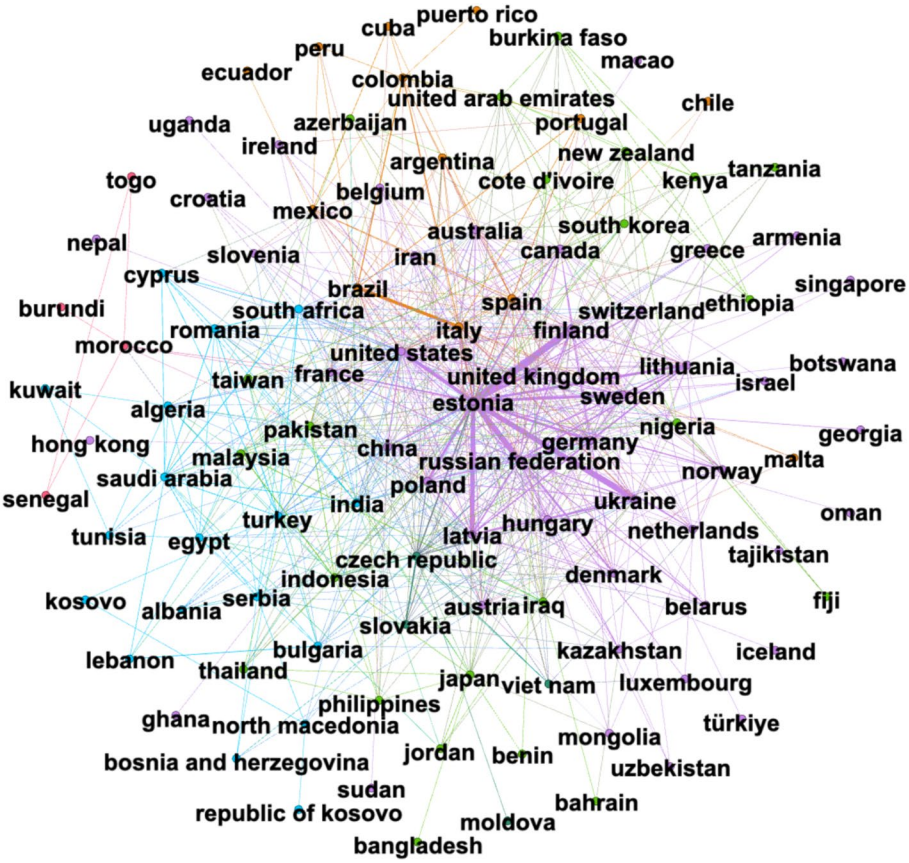

Fig. 7 The country-based co-authorship network of Estonian journals

other countries in the collaboration space. Its betweenness centrality is extremely high (794.855), which implies a pronounced brokerage role connecting otherwise weakly linked national clusters.

A dense secondary core is formed by large research systems with both high degree and high tie strength, most notably China (71 links; 899 total link strength). Anglophone hubs are similarly prominent, with the United Kingdom (70 links; 319 total link strength) and the United States (68 links; 515 total link strength) occupying highly connected positions that reinforce the journals' global embedding. Regional and European integration is evident in the strong presence of Poland (68 links; 499 total link strength) and Spain (62 links; 255 total link strength), Germany (53 links; 198 total link strength) and France (50 links; 148 total link strength).

Lithuania is the only network where several non-European or non-EU mid-core partners contribute to the network's breadth, including India (64 links; 232 total link strength) and Turkey (55 links; 182 total link strength), Malaysia (48 links; 226 total link strength) and South Africa (48 links; 115 total link strength) as well as (41 links; 279 total link strength) and the Russian Federation (40 links; 155 total link strength) (Fig. 9, full node results are in Appendix 1, sheet 3).

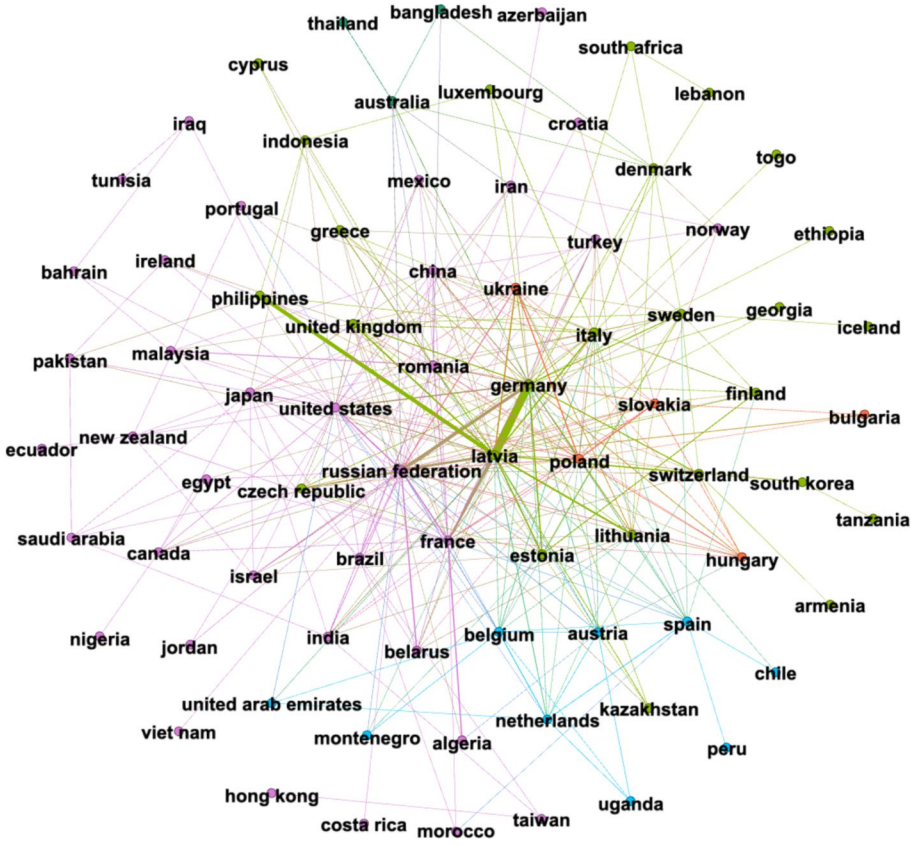

Fig. 8 The country-based co-authorship network of Latvian journals

Discussion

"Slow but still"—thoughts on the evolution of Baltic journals

Despite significant historical disruptions, Baltic journals have managed to grow, albeit at a measured pace, and remain largely regionally focused with some international integration. Our results indicate that while progress has been made, particularly in digital adaptation and publication volume, challenges persist in terms of prestige, citation impact, and international collaborations. One of the most important findings is the disparity between the number of Baltic journals indexed in Scopus and their relative standing within global rankings. The majority of these journals are positioned in lower quartiles (Q3 and Q4), with only a few achieving Q1 status. It can be claimed, therefore, that while there is a growing body of work emerging from Baltic scholars, the broader scientific community does not yet fully recognize these journals as leading venues for cutting-edge research reaffirming the Demeter's (2017) core-periphery theory where marginalized regions struggle to "leave the periphery". This aligns with findings in previous research on peripheral academic publishing, where local journals often face visibility and impact limitations compared to their Western European and North American

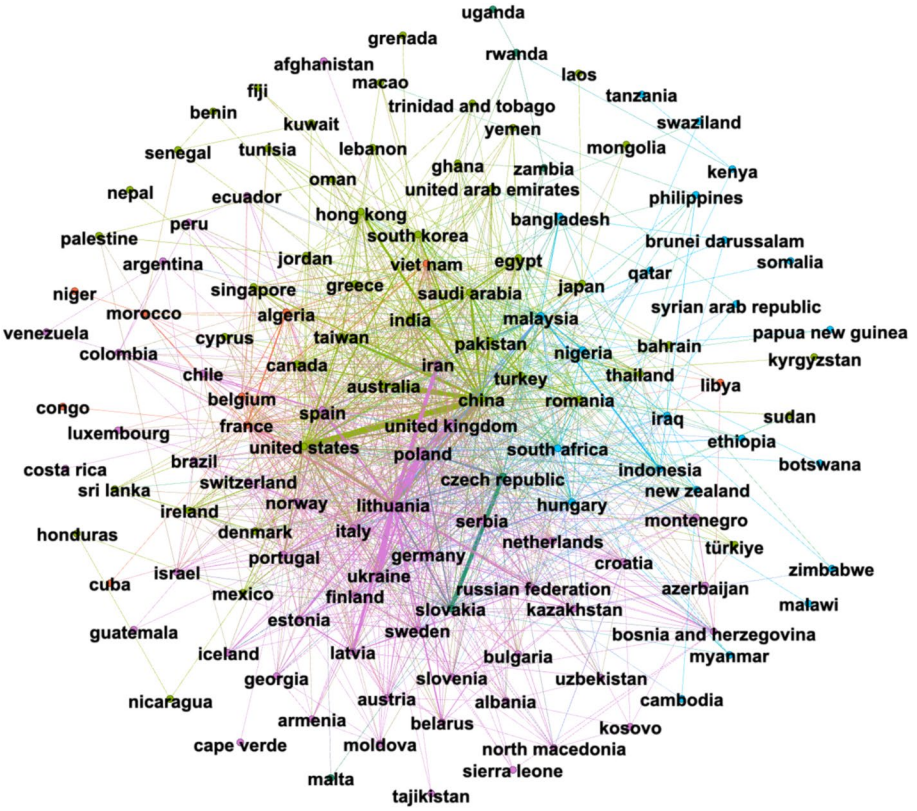

Fig. 9 The country-based co-authorship network of Lithuanian journals

counterparts (Asubiaro et al., 2024; Demeter, 2020; Kohus et al., 2022; Lund et al., 2021; Sasvári & Lendvai, 2024).

In terms of publication growth, the data show a gradual increase over time, with a notable acceleration post-2000. This upward trend aligns with the broader global shift toward digital dissemination (Shrivats & Bhattacharya, 2014), as well as increased access to international opportunities and publishing tools. However, fluctuations in output in the early 1990 s, likely tied to post-Soviet restructuring, highlight the ongoing challenges in building a stable and competitive research infrastructure. Citation trends further confirm the relatively modest impact of Baltic journals (cf. Zavadskas et al., 2011). The mean total citations per article remain low, and citation accumulation tends to decline over time. While this pattern is not unique to the region (Kohus et al., 2022; Sasvári & Lendvai, 2024; Zavadskas et al., 2011), it does highlight the need for more strategic efforts to increase article visibility, such as indexing in more databases, fostering stronger international collaborations, and aligning with high-profile research agendas.

International collaboration patterns reveal another important insight at the level of locally embedded journals. Although the share of multi-country publications has increased over time, Baltic local journals remain relatively "insular" in their co-authorship structures, a pattern also observed in other semi-peripheral EU regions such as the Visegrad countries (Kohus et al., 2022; Sasvári & Lendvai, 2024). The latter is mentioned is it can be

comparatively confirmed that in the case of Baltic journals as well, the co-authorship analyses are characterized by a strong concentration of domestic collaborations, with comparatively limited participation from authors affiliated with high-impact research economies in Western Europe or the United States. Nonetheless, a certain of level caution is needed in this regard, as this pattern may reflect the scope, orientation, and audience of local journals rather than broader national research behavior. A notable exception within the local journal landscape is the marked increase in Chinese-affiliated contributions, particularly in Lithuanian journals (see Fig. 9). Previous analyses by Leiden University researchers identified early signs of rapidly growing China–Europe co-authorship ties in Central and Eastern Europe during the 2010–2018 period, with growth rates substantially exceeding those observed in Western Europe (van der Wende et al., 2020). In the context of Baltic local journals, this trend raises questions about the nature of such collaborations, specifically, whether they show sustained academic partnerships or more strategic publication practices aimed at international visibility through regionally indexed journals (cf. Lasauskienė et al., 2017). This interpretation is further contextualized by Lithuania's relatively permissive open access publishing environment, including the prevalence of journals offering OA without article processing charges (Kepalienė, 2020), which may increase their attractiveness as publication outlets within global academic circuits.

Key challenges that still persist

Building on the empirical findings presented above, this section interprets the observed publication, collaboration, and prestige patterns in light of the structural and institutional conditions shaping local journal publishing in the Baltic states. One of the issues which can be related to the rather slow emergence of internationally indexed journals is stems from the Baltic research dissemination system. Despite great efforts, for almost 20 years, scientific journals in the Baltic States have been struggling to integrate into the global science dissemination system and adapt to the digital format (Petreikis et al., 2024a, 2024b; Zavadskas et al., 2011). The vast majority of scientific journals have already switched to digital publishing, although some still print journals. The transition to digital formats for humanities and social sciences journals took longer than for natural, medical or technological sciences. The year 2002 is considered a turning point, when the majority of scientific articles in the world began to be read in digital, rather than printed, format (Odlyzko, 2002). The Baltic countries have not lagged behind global trends, for example, in 2005 an electronic publishing department was established at the publishing press of Kaunas University of Technology (Lithuania), and some journals have started to be published in digital format. However, publishing in digital format was not the biggest challenge for scientific journal publishers (especially in the humanities and social sciences). The most difficult was the transition to using professional article acceptance, review and publication software. Only specialized software specifically designed for scientific journals can offer the functions required for modern scientific publishing, including publication process management, review control, integration with databases and increased dissemination (Moradzadeh et al., 2022). Journals that did not transition, or transitioned late, to specialized scientific publishing systems often faced dissemination problems, credibility image problems, sometimes even risking being confused with predatory publications (Teixeira Da Silva et al., 2023). However, in order to improve journal management processes and dissemination, most scientific journals in the Baltic States have now switched to

specified scientific journal publishing systems. The most commonly used publishing software in the Baltic States is the Open Journals System (OJS), for example, in Lithuania it is used by about 50 percent of scientific journals (by the way, social science journals do this much more often than others), although about a third of journals use handmade websites for publication, and e-mail for accepting and reviewing articles (Petreikis et al., 2024a, 2024b and also see Gudinavičius et al., 2023).

There are also problems with the quality of peer review. The Baltic States are small countries, with relatively small populations and even smaller scientific communities with distinct linguistic characteristics (Gudinavičius et al., 2023). This leads to the fact that scientists from different scientific fields in their countries know each other quite well and come together in various formats (in peer review, joint projects, etc.) (cf. for dense collaboration networks: Danús et al., 2023). Under such conditions, ensuring high-quality anonymous peer review is quite difficult, because after receiving an anonymized manuscript for review, it is quite easy to determine who wrote it (if the manuscript is written in the national language, Gudinavičius et al., 2023). Furthermore, Journal editors often find it difficult to find reviewers who are both good experts in the field and could be impartial reviewers. The number of possible reviewers is also limited by the language of the manuscript—if it is submitted in one of the languages of the Baltic States, reviewers have to be sought only in their own country (Gudinavičius et al., 2023). Though, in recent years, the globally noted pressure has been increasing on scientists from organizations evaluating science to publish in English, the object of research is also of national importance, publishing in English raises doubts, because such publications receive less attention in the country whose problem they are intended for (Hamel, 2007).

Lastly, though not-measurable purely on Scopus data, the economic dimensions of contemporary scholarly publishing must also be mentioned as it shapes the trajectories of local journals. The growing prevalence of open access (OA) publishing has substantially altered the visibility, accessibility, and circulation of scholarly work worldwide. Previous research suggests that Eastern European countries tend to publish a relatively higher share of their output via OA channels (Maddi et al., 2021), and recent Lithuania-focused evidence similarly indicates a notable increase in OA publishing practices (Tautkeviciene, 2024). At the same time, however, OA publishing often entails new financial pressures through Article Processing Charges (APCs), which may disproportionately affect journals and authors operating in semi-peripheral research systems with limited institutional funding and smaller domestic research markets. For locally embedded journals in the Baltic states, these dynamics create a complex trade-off situation where OA models may enhance international visibility and readership, APC-based publishing can constrain author participation (see Williams et al., 2023), limit editorial flexibility, and raise concerns regarding long-term journal sustainability, particularly in disciplines where dedicated funding for publication fees is scarce. Moreover, as noted by Grančay et al. (2017), the expansion of OA has coincided with the proliferation of predatory publishing practices, which further complicates the strategic environment for local journals seeking international recognition while maintaining academic credibility. Subsequently, the economic and institutional pressures point to an important issue yet to be addressed which is that the internationalization of Baltic journals cannot be understood solely through citation metrics or indexing status but must also be situated within the broader political economy of OA publishing and research evaluation regimes.

Quo vadis, Baltic science?—future agenda and limitations

As for future and practical agenda, as outlined above, a key challenge for Baltic journals moving forward is improving their integration into the global research ecosystem while maintaining their regional identity. Encouraging greater international collaboration through funding mechanisms, research networks, and open-access initiatives could enhance the visibility and impact of Baltic research (see the case of Visegrad countries, Kohus et al., 2022). Additionally, adopting best practices in journal management—such as improving peer review processes, enhancing editorial board diversity, and increasing transparency in publication standards—could help elevate journal reputation and attract high-quality submissions from a broader range of scholars. Furthermore, the rise of Chinese co-authorship in Lithuanian journals presents an intriguing phenomenon that warrants further investigation. Future research should examine the motivations behind these collaborations, whether they stem from genuine academic partnerships or strategic efforts to leverage Baltic journals for publication output as understanding these dynamics could provide valuable insights into broader trends in global academic publishing and the role of regional journals in facilitating cross-national research exchange. Finally, as language barriers continue to pose a challenge, especially in the Baltics (Gudinavičius et al., 2023), as many Baltic researchers are pressured to publish in English for greater visibility, yet this may limit the accessibility of research for local policymakers and practitioners. Future studies should investigate how bilingual, or multilingual publishing models might support both international dissemination and local impact.

Although our study provides a comprehensive scientometric analysis of Baltic journals, a few limitations must be acknowledged. First, the study relies on data from Scopus and ScimagoJR, which, while widely regarded as authoritative sources, only covers exclusively indexed journals and does not cover domestic and regional journals often written in domestic languages (Gudinavičius et al., 2023). Future research could benefit from incorporating additional databases such as Web of Science and national repositories to provide a more holistic view of scholarly output in the region (cf. Zavadskas et al., 2011). Another limitation relates to the focus on journal-based metrics such as quartile rankings and SJR scores, which, while valuable indicators of prestige and impact, do not account for alternative measures of academic influence such as policy impact, public engagement, and societal relevance (Kim & Chung, 2018). It could be, therefore, important to explore in the future qualitative dimensions of journal influence, such as their role in shaping national research agendas and fostering early-career researchers.

Conclusions

Following their regained independence, the Baltic countries restructured their scientific journal publishing, gradually integrating into the global scientific periodical system. The rise of digital publishing in the twenty-first century facilitated this process, leading to a significant increase in publication output. However, Baltic scientific journals remain largely regional with limited international integration and recognition. Despite an increase in journals indexed in Scopus, their impact and visibility remain low.

Our analysis of Scopus journal and publication trends reveals that social sciences and humanities dominate the top subject categories, particularly in linguistics, language, and

history. However, there is no overwhelming subject category domination in any country's journals. A major limitation is the lack of elite journals—only a small percentage achieved a Q1 ranking, with Lithuania showing the lowest proportion at just 5 percent. Most journals fall within Q3-Q4 quartiles, with linguistics, language, and cultural studies being the most frequently represented in the top quartile. The prestige score (SJR) of Baltic journals is significantly low. Among the 111 Scopus indexed Baltic journals, Lithuania had the highest average SJR (0.244), followed by Estonia (0.204) and Latvia (0.177). Notably, the most prestigious journals in these countries primarily belong to technical sciences, while humanities and social sciences journals are underrepresented among the most productive sources. This suggests a dominant focus on technical and industrial research. Citation analysis shows low overall citation rates, with a steady decline in citations for older articles.

In terms of internationalization and collaboration, Lithuania leads in publications production, followed by China, despite the geographical and cultural distance. Estonia and Latvia follow in contributions, with neighboring countries like Russia, Czech Republic, and Ukraine also making significant contributions. Western countries such as Finland, Italy, the USA, Germany, and Spain contribute less to comparison. Notably, Estonia and Poland exhibit higher international collaboration shares than Lithuania and Latvia, suggesting stronger integration into global research networks. It correlates with initiatives to elevate visibility of Baltic research, for example, Estonia and Latvia are demonstrating efforts (https://www.researchlatvia.gov.lv, https://researchinestonia.eu) to increase research visibility through official state website sections dedicated to science, an initiative absents in Lithuania. An intriguing finding is the minimal collaboration with Nordic countries, despite their geographical proximity, except for Finland, which collaborates primarily with Estonia. The rapid increase in China's research production within Baltic journals is self-reinforcing, positioning it as a potential leader in research output in these journals. If this trend persists, China may surpass even Lithuania within Lithuania's domestic academic publishing landscape. Possible explanations include a relatively lower quality review process due to limited international engagement, and the absence of article processing charges in Baltic journals. However, further research is necessary to validate these factors.

In conclusion, despite a growing presence in global academic publishing, Baltic scientific journals continue to face significant challenges related to international visibility, impact, and collaboration. The dominance of social sciences and humanities in Baltic journals is counterbalanced by the greater prestige and influence of technical sciences. International collaborations remain limited, particularly in Lithuania, where domestic research predominates. The increasing involvement of China in Baltic research publishing signals a shifting landscape, necessitating further scrutiny to understand its implications. Moving forward, strengthening international collaboration, improving journal quality, and increasing visibility through dedicated initiatives could enhance the impact and global integration of Baltic research publishing.

Appendix 1

Network metrics (node statistics) for the three Baltic countries' co-authorship networks (by country): https://docs.google.com/spreadsheets/d/1hRFEa4m9ge-Wr_e26v_Ev667zE91MYDK/edit?usp=share_link&ouid=112540521537191091429&rtpof=true&sd=true.

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Data availability The datasets generated during and/or analyzed during the current study are not publicly available due to the fact that institutional access is needed to Scopus and SciVal but are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval Not applicable.

Informed consent Not applicable.

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